

Barriers to the Adoption of Prevention through Design (PtD) Controls among Masonry Workers

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Abstract

Dust from masonry operations affects not only the workers involved in direct exposure-causing tasks, but also those performing ancillary activities. Dust generated by these operations contains quartz, which has been classified as ‘group-I human carcinogen’ by the International Agency for Research on Cancer. To reduce dust generation during masonry activities, various Prevention through Design (PtD) control options are available. However there is lack of systematic adoption of the control options among the workers. The objective of this study was to identify the barriers to the adoption of PtD controls among the masonry workers. Survey research methods were employed for this study and member companies of the Mason Contractors Association of America were selected as the sample. Content analysis of the survey data identified decline in productivity due to the use of PtD controls as the major barrier. Other emergent themes include unsuitable work conditions and lack of trust in technology.

Keywords: Prevention through Design (PtD), masonry, dust, silica.

1. Introduction

Crystalline silica is a ubiquitous mineral and a basic component of soil, sand, granite, and many other minerals. Occupational exposure to silica occurs in a large number of industries, such as construction, mining, quarries and granite production and many others. An estimate of nearly two million workers in the United States are exposed to respirable crystalline silica in their occupational environment (OSHA, 2002). Occupational exposure to silica has been considered as a possible risk factor for several diseases: silicosis, lung cancer, pulmonary tuberculosis, and chronic obstructive pulmonary disease (WHO, 2000). Some autoimmune diseases may also be associated with occupational

crystalline silica exposure; such as, rheumatoid arthritis and scleroderma (McCormic et al., 2010).

Silica exposure continues to be an important hazard in the construction industry and, therefore, remains a concern for the health and safety of construction workers. The construction industry has the highest rate of silica-related occupational fatality among all industrial sectors (Linch, 2002). Followed by sandblasting, other construction activities that result in severe silica exposure include jack hammering, rock/well drilling, concrete mixing, concrete drilling, and brick and concrete block cutting and sawing (OSHA, 2009). The dust generated by concrete and masonry operations contains respirable silica. This dust affects not only the workers involved in direct exposure-causing tasks, but also those performing ancillary activities. An examination of data provided by the Occupational Safety and Health Administration (OSHA) suggested that occupational categories such as masonry, stonework, tile setting, and plastering (Standard Industrial Classification (SIC) code group 174) are potentially more over-exposed to respirable silica than any other SIC code group (Linch et al., 1998). One author suggests that current “silica exposures are grossly unacceptable” and interventions are necessary to reduce worker exposures (Rappaport et al., 2003).

Review of existing literature reveals that interventions, in the form of Prevention through Design (PtD) control options, are available for the reduction of dust generation during masonry activities. Some of the effective control techniques include use of tool-mounted local-exhaust ventilation (LEV), area ventilation, wet methods, and sweeping compound for clean-up activities. However, for the PtD controls to be effective, they must to be used regularly and become a part of normal work process. It requires ongoing management support and worker acceptance to be effective. In reality, the use of PtD controls in the masonry industry is very sporadic and lacks systematic adoption. Since the decision to adopt/purchase PtD control technologies is made at management levels of the organizations, the objective of this study was to identify the owners’ perception on the barriers to the adoption of PtD controls.

2. Intervention Methods

In a generic way, intervention can be defined as an attempt to change how things are done, in order to make an improvement (Robson et al., 2001). Interventions can be designed to prevent hazards at any of the three locations: (i) at the source; (ii) in the path between the source and the receiver, and (iii) at the receiver as shown in Figure 1.

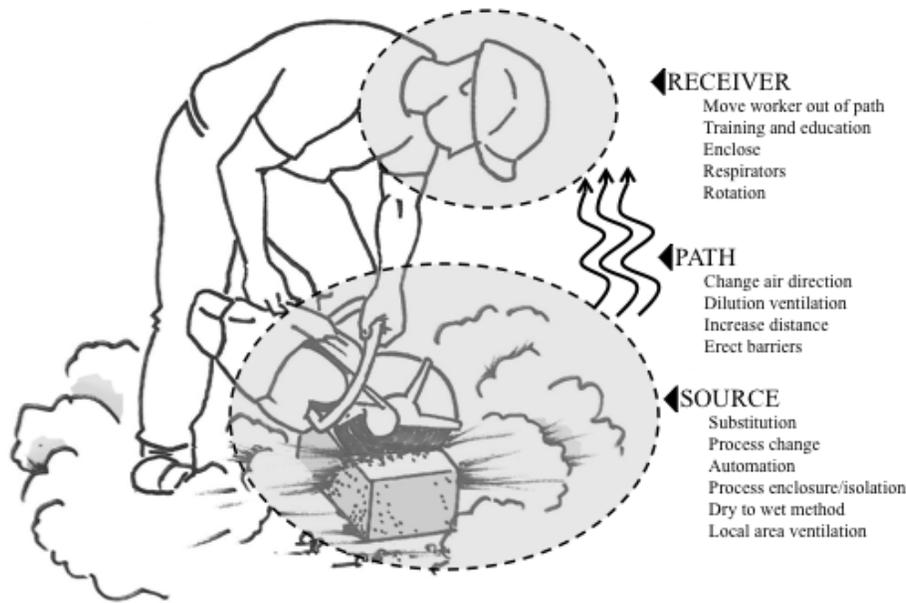


Figure 1: Interventions to prevent hazard exposures

Intervention practice uses a hierarchy of controls to prevent hazard at the source, substituting with less hazardous materials or processes as the ideal approach. However replacing concrete or brick as building materials is not feasible at this time. With the rise in the price of steel, buildings are being constructed with even more concrete. The aggregate, particularly granite, used in concrete is the primary source of respirable crystalline silica exposure during concrete cutting and finishing operations.

Changing the process will require more focused improvements in design and construction planning that may reduce some of the concrete cutting (after it is poured in place). Such improvements would require a specific commitment to planning, scheduling, and integration by all the parties involved in the construction project (Hecker and Gambatese, 2003). In most situations, the level of planning required to achieve the desired integration remains unrealized in the construction industry. The use of personal protective equipment (intervention at the receiver) is considered the least desirable approach to controlling construction health hazards. However respiratory protection is the primary, though still relatively underused, dust exposure reduction method currently used in construction. Studies have indicated that respiratory protection equipment is often not available or not used properly and that it may not provide sufficient protection from respirable crystalline silica for many tasks (Tjoe-Nij et al., 2003, Flanagan et al., 2006).

Several PtD control options are available for the reduction of dust generation during concrete and masonry activities. The Occupational Safety and Health Administration (OSHA) has recommended the use of PtD controls based on their performance in controlled environments (OSHA, 2009). General categories include: local-exhaust tool-mounted ventilation, area ventilation, wet methods, and sweeping compound for clean-up activities. Cutting, grinding, and sawing tools can be equipped with local-exhaust ventilation (LEV), which has been found to be very effective (Akbar-Khanzadeh and

Brilhart, 2001). Wetting of the substrates before or during abrasive operations has also been found to be effective (Akbar-Khanzadeh et al., 2007). Area ventilation, if properly designed, can offer some worker protection, although not as effectively as local-exhaust ventilation. Sweeping compound is composed of dyed sawdust, sand, and mineral oil and if spread over the floor before sweeping helps to keep down the dust. However, for any intervention to be effective it not only has to be effective but also must be accepted as part of daily work process.

The adoption of the PtD controls is dependent on the perception of the firm owners to a large extent. Some studies have examined the barriers and incentives for the implementation of interventions to improve occupational health in construction; but they are few in number. Other studies conducted by Akbar-Khanzadeh et al. (2007), Flynn and Susi (2003), Hess et al. (2004), Meeker et al. (2007), Neitzel and Seixas (2005), Rempel et al. (2010), Young-Corbett and Nussbaum (2009) have focused on the efficacy of the intervention rather than the implementation process.

3. Objective

Adoption of increased number of PtD controls can reduce risks to the workers from dust exposure. But there are certain factors, which act as barriers to the adoption of these controls. Hence, identification of the barriers to the adoption of PtD controls is necessary to increase the systematic adoption. Further, the recognition and significance of these barriers can vary among the firm owners. The objective of this study was to evaluate the firm owner perceptions of risks associated with masonry dust and potential barriers to the use of PtD controls.

4. Methods

A survey research method was adopted for this study. The overall research process of the study involved the following steps: (1) selecting sample masonry firms; (2) developing the survey instrument; (3) performing cognitive interviews for instrument validation; (4) administering the survey and collecting data; and (5) analyzing the collected data.

Sample selection

To evaluate PtD control use in the masonry trade sector, the members of the Mason Contractors Association of America (MCAA) were identified as the sample population of interest. MCAA is the foremost national trade association representing masonry contractors and suppliers in national legislative and political affairs, codes and standards composition, workforce development, education, market promotion, and general industry advocacy. The association's membership of over 1000 firms accounts for \$2 billion in masonry sales annually. For the purpose of this study, the member firms of MCAA who are headquartered in Virginia (n=15) were selected as the sample.

Survey instrument development

The individual survey questionnaires were composed of two types of questions: (i) close-ended questions with ordered choices and (ii) open-ended questions. The questionnaires were divided into two parts: (i) close-ended questions addressing key demographic information of interest: type of project(s) the firms deliver, contractual roles of the firms, annual revenue of the firms, and number of employees; and (ii) open-ended questions regarding perceptions of the respondents regarding: health impact of masonry dust and about use of tool-mounted local-exhaust ventilation, area ventilation, wet methods, and sweeping compound. Respondents answering “rarely” or “never” on these items were subsequently asked “why not?” Survey respondents were also asked to list any additional methods for controlling dust employed by their firms and to share any additional information about their experience with dust and dust control.

The survey instrument development process is summarized in Figure 2 and described below.

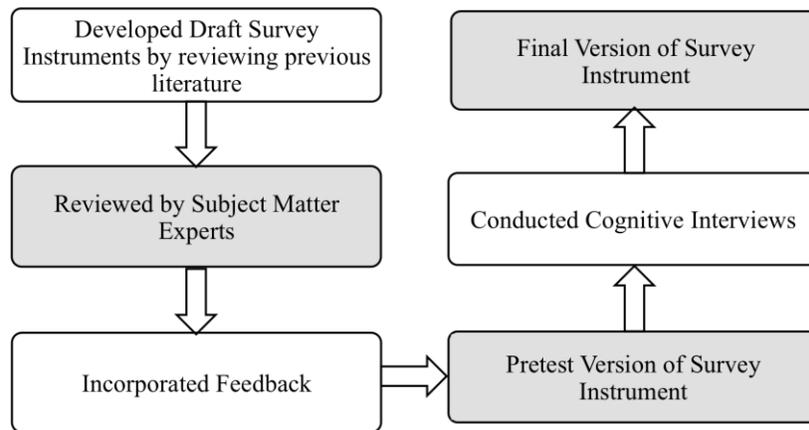


Figure 2: Survey instrument development process

The authors identified the survey items based on the study’s key constructs of interest. Once the first drafts of the survey instruments were developed, a research measurement expert and two subject matter experts in construction reviewed those in order to ascertain the content validity of the items in terms of relevance, representativeness and technical quality. Feedback from the subject matter experts was incorporated into the second draft, the pretest version of the survey instruments.

Instrument validation

The pretest versions of the instruments were next evaluated for substantive and structural validity through cognitive interview procedures. Cognitive interviewing techniques, based on works of Willis et al. (1999) using a concurrent, scripted probing method were employed. Two experts from the construction industry were included for the cognitive interviews. Information obtained from the cognitive interview sessions were incorporated

into final version of the survey instruments. Several typographical errors were corrected and several words in the questions were revised to increase clarity.

Data collection

Each of the 15 mason contractors headquartered in Virginia was contacted until reached, or to a maximum of three attempts. These attempts were made at different times of day and on different days of the week. Out of the sample size of 15, the owners of five organizations agreed to participate in the study, representing a response rate of 33.33%. After agreeing to participate, authors provided them background information about this study and appraised them about the requirements for data collection. The survey was conducted over phone following a standard protocol during April 2011. Interviews began with a brief summary of project objectives, a review of informed consent information, and an assurance that firm identity would never be linked to responses and that only aggregate data would be published.

Data analysis

Content analysis was utilized for analyzing the data from the open-ended questions. The authors examined the transcriptions to see what categories emerged and how those categories were related. Subsequently, these categories became the themes of the study. Data analysis began with the coding of each individual interview transcript. Authors reviewed the interview transcripts to identify key terms or phrases that summarized participant responses. After the second iteration, a table of exhaustive and mutually exclusive codes was created. These codes were then assigned to responses.

5. Findings

Based on the responses of the closed ended questions, all the respondent firms had been involved with the following types of projects: residential, office, educational and retail as subcontractors. The firms reported their annual revenue in the range of one to five million USD and they had employees in the range of 101 to 200.

Perception of risk

The respondents identified mainly two types of potential risks with dust exposure: (i) impact on workers' health, and (ii) customer satisfaction. However the comments pertaining to the health did not indicate their perceived risk towards workers' health due to exposure to dust. While two respondents identified crystalline silica present in the dust as hazardous to workers health, their overall perception could be captured in the following comment: "you cannot work in construction and remain dirt free...dust is a part of our job". All the respondents had been working in the construction industry in excess of 10 years (ranged from 10 – 30 years) and had considered the dust generated by the operations as part of it. Their workers were suggested to wear respirators, but not made mandatory. None of their workers had ever experienced lost day away from work

due to dust exposure; neither firms had any worker's compensation claim due to dust exposure ever.

Perceived risk to customer satisfaction due to dust was evident from the responses. While most of the time working outside it was not possible to keep the dust under control, customer always complain about dust. But they made conscious efforts to keep the dust within control, as they wanted "repeat business" with the clients.

Use of PtD control technologies

Among the PtD control technologies, wet method was most commonly used by the respondents followed by use of sweeping compound (interior work), and tool-mounted local-exhaust ventilation. None of the respondents had used area ventilation in any of their projects so far. Respiratory protection was also identified as the most commonly used method of controlling worker exposure to dust. However, the use of respiratory protection is not mandatory and had been left on workers' discretion.

Analysis of the open-ended comments revealed key barriers to the adoption of PtD control technologies that can be categorized under three emergent themes: (i) decline in productivity; (ii) unsuitable work conditions; and (iii) lack of trust in technology. Respondents expressed concerns over usability of tool-mounted LEV (for tuck-pointing and grinding) and that it would take longer for the workers to learn the use of the technology. In addition, productivity issues identified were that the workers currently had a level of proficiency with the traditional tools and that the more complicated LEV tools would hamper their desired productivity. Also noted were problems associated with the size of the LEV and how that limit maneuverability in tight spaces. While majority of the tools used by the respondents were battery or gas operated, additional attachments for the LEV would constrain and limit worker movement. Also, the need to empty dust collection containers and lines was perceived as a hindrance to productivity. Several respondents mentioned a common work condition factor: PtD control technologies require power sources and this was not always available in locations close enough to the work. Moreover, as most of the works were outside there was minimal use of sweeping compound to control the dust.

Comments pertaining to wet methods identified it as the most commonly used control technology. Though no productivity issues were identified with this control technology, respondents pointed out the need for rinsing the equipment frequently. None of the respondents had used local area ventilation and were unfamiliar with the technology. Another common theme that emerged from the analysis was the pervasive lack of trust on the PtD control technologies. Most comments pertained to the belief that these control technologies did not provide dust control, dust was still generated and workers were covered with dust.

6. Discussion

Responses to the open-ended questions confirmed the understanding of the masonry firm owners that masonry dust contains crystalline silica. Several comments indicated the perceived understanding of the health risks to the workers due to the dust exposure, and some reflected the desire to reduce the dust and need for improved control technologies. However there was a strong undercurrent of an implicit acceptance of the risk of dust exposure as being inherent to construction activities, and to some extent unavoidable. Interestingly, respondents perceived a serious threat to customer satisfaction due to dust especially in educational and office projects. This indicated that masonry firm owners were not focused on the objective risk to workers.

Content analysis of the responses revealed that some firm owners misunderstood the difference between ambient dust control and dust control to protect workers from exposure. While ambient dust could be controlled by sprinkling water, that could not control dust generation from the activities within worker breathing zone. Respirators could reduce the threat to dust exposure but its use was not consistent. The prevailing theme was that the owners considered it the responsibility of the worker to wear the respiratory protection. There was a clear lack of perceived role on the part of the owners in establishing policies and protocols to improve the adoption of PtD control technologies by the workers.

Limitations and future direction

There were several limitations to the present study. The work presented in this paper describes the pilot data collection stage of ongoing work; therefore, the sample size was small. Ongoing phases of the project involve the use of a validated instrument with both quantitative and qualitative items. The second limitation of the study was the selection of sample firms that had membership with larger trade organizations. As a trend, firms that opt to join trade organizations tend to be larger in size (Young-Corbett, 2007). Thus the present study only included the perception of the larger firms and lacked the input of the relatively smaller sized firm owners. Future study will include firms of varying sizes in the sample. Finally, the assumption that decision to adopt/purchase PtD control technologies is made at management levels of the organizations was supported, in a majority of the cases. However, the perception of the workers also plays an equally important role in adoption of the PtD control technologies. Further research will be necessary to examine the perception of the workers along with that of the firm owners.

7. Conclusion

Perception of risk is a critical antecedent of mitigating risk. Thus for the adoption of any intervention for mitigating risks, it is important to examine the decision makers' perception of risk – there is an association between risk perception and adoption of interventions. One of the objectives of this study was to evaluate the masonry firm owners' perception of risk from masonry dust exposure. While there is a common

understanding that masonry dust contains crystalline silica that has detrimental effects on the workers, still the workers accept it as inherent and unavoidable part of the operations. The second objective of this study was to identify the key barriers to the adoption of PtD control technologies in the masonry trade. Inputs of particular importance are in the form of the three emergent themes of barriers such as decline in productivity, unsuitable work conditions and lack of trust in technology. These themes will provide inputs into the improvement of existing control technologies as well as in the design of effective controls technologies in the future to protect masonry workers from dust.

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